that decreased CPP accounted for ≈50% of the decrease of DP during ↓CF. These data are consistent with the hypothesis that CPP and Pi are the major mediators of contractile dysfunction during mild↓ CF.

11:30

784-5 Importance of Glycolytic Substrate for Energy Preservation During Inotropic Stimulation of Ischemic Myocardium

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Introduction: During ischemia (Isc) restoration of contractile function by dobutamine (Dob) or other positive inotropic agents is accompanied by hastened depletion of high energy phosphates. We tested if increased glycolytic substrate (19.5 mM glucose and 200 μU/ml insulin) (G + I) could preserve energy reserves and function during ischemia and reperfusion. *Method:* Isolated isovolumic, blood perfused rabbit hearts were exposed to 90 min of low-flow Isc by reducing coronary perfusion pressure from 80 to 20 mmHg. Additional stress (S), simulating acute myocardial infarction and shock was imposed by increasing LVEDP from 10 to 25 mmHg, heart rate from 3 to 5 Hz and by giving i.c. epinephrine (1000 pg/ml), norepinephrine (1500 pg/ml), and Dob (5×10^{-6} M) (Control = C; n = 8). G + I (n = 8) was given i.c. 10 min after the onset of Isc + S. *Results:* At 85 min Isc, G + I group vs C had a higher rate-pressure product (RPP) (15 ± 0.8 vs 9.7 ± 1.1 mmHg/min/1000; $p < 0.01$), +dP/dt, −dP/dt and lower LVEDP (23 ± 2 vs 55 ± 4 mmHg, $p < 0.01$). Oxygen consumption was similar, but glucose consumption (2.5 ± 0.5 vs 0.9 ± 0.1 μmoles/min/g, $p < 0.05$) and lactate production were increased, indicating an increased glycolytic flux. During reperfusion, G + I had better LV developed pressure (61 ± 4 vs 34 ± 5 mmHg, $p < 0.01$), LVEDP (24 ± 2 vs 50 ± 3 mmHg, $p < 0.05$) and efficiency of oxygen utilization (oxygen consumption/RPP) (0.26 ± 0.02 vs 0.47 ± 0.05 μmoles/min/g/mmHg/min/1000, $p < 0.01$). Dob stimulation severely decreased high energy phosphates, which were protected in part for Dob + G + I vs Dob alone: ATP (9.9 ± 0.9 vs 6.4 ± 0.4 μmoles/min/g, $p < 0.01$) and CP (14.2 ± 2.4 vs 6.5 ± 1.5 μmoles/min/g, $p < 0.05$).

Conclusion: It is beneficial to increase metabolic (i.e. glycolytic) substrate, when ischemic myocardium has to be stimulated by catecholamines, such as during cardiogenic shock.

11:45

784-6 Metabolic Control of Contractile Performance: Evidence Against Regulation by [Pi] in the Normal Perfused Rat Heart

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Changes in [Pi] have been postulated to account for the initial down regulation of contractility during hypoxia and ischemia. This study investigates the role of [Pi] in the control of myocardial performance in the well oxygenated Langendorff perfused rat heart. ^{31}P NMR was used to quantitate [Pi], [ATP] and asses pH_i during substrate transitions and [Ca^{++}]-linked changes in myocardial performance. Following a glucose to pyruvate switch, [Pi] declined from 4.6 mM to 0.3 mM while rate pressure product (RPP) significantly increased from 29600 to 36500 mmHg min^{-1}. No change was noted in [ATP], while pHi declined from 7.11 to 7.06. When hearts were switched from glucose to glucose buffer containing 1 mM dichloroacetate (DCA) to activate pyruvate dehydrogenase, no functional change was observed in spite of a 2-fold increase in [Pi]. Likewise, when glucose + DCA perfused hearts were switched to lactate + DCA buffer, function remained constant while [Pi] declined from 6.7 to 1 mM. Changes in free buffer's calcium concentration from 0.5 to 3.5 mM induced 6-fold elevations in RPP in glucose pyruvate or lactate perfused hearts. In all cases, increases in RPP paralleled [Pi], although at similar performance levels [Pi] was markedly different for each substrate. Thus, changes in [Pi] are critically influenced by metabolic substrate, independent of contractile performance. Our data show that in the normoxic state changes in [Pi] have little or no correlation to function. We conclude that under these conditions [Pi] is not an important regulatory metabolite.

785 Valvular Heart Disease: Clinical Assessment

Wednesday, March 27, 1996, 10:30 a.m.–Noon
Orange County Convention Center, Room 314

10:30

785-1 Physiologic Impact of Pulmonary Venous Flow Reversal in Mitral Regurgitation: A Computer Modeling and Doppler Hemodynamic Study

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Many studies have highlighted the value of pulmonary venous flow reversal (PVFR) to assess mitral regurgitation (MR). However in the presence of severe MR, the physiologic significance of the presence or absence of PVFR is unclear. *Methods:* Computer modeling (with a previously published model of the atrium and PV tree) using large regurgitant volumes has shown that PVFR reflects the interaction of regurgitant volume with left atrial compliance and volume. The model shows that PVFR is due to rapidly rising atrial pressures which exceed PV tree pressure. Therefore PVFR should result in the retrograde transmission of those pressures. However, these hemodynamic consequences of PVFR have not been documented. We explored this possibility in 41 consecutive pts (age 65 ± 12) all of whom had large volume regurgitation as assessed by quantitative Doppler echo (regurgitant fraction > 50%). Systolic pulmonary artery (PA) pressure was calculated using peak tricuspid regurgitant jet velocity as measured with continuous wave Doppler. *Results:* All pts had high volume MR (regurgitant volume = 107 ± 35 mL/beat) but those with PVFR (n = 25) had statistically higher PA systolic pressures than those without PVFR (n = 16): 58 ± 20 vs. 45 ± 11 mmHg ($p = 0.03$). The pts with PVFR also had a lower cardiac index: 2.2 ± 0.3 vs. 2.5 ± 0.5 L/min/m^2 ($p = 0.03$). Left ventricular volume, ejection fraction, and left atrial volume were not different in the two groups. *Conclusion:* In pts with large volume MR, PVFR indicates a poor hemodynamic tolerance with high PA pressures and reduced cardiac index. Therefore the occurrence of PVFR provides information above and beyond estimating regurgitant volume and provides a window into the hemodynamic impact of MR.

10:45

785-2 Influence of Ejection Fraction and Aortic Regurgitation on the Accuracy of Aortic Valve Area Determination

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Background: The influence of left ventricular dysfunction and aortic regurgitation (AR) on commonly used methods for aortic valve area (AVA) determination has not been fully evaluated.

Method: AVA determinations by transesophageal echocardiography (TEE) using planimetry, transthoracic echocardiography (TTE) with application of the continuity equation, and cardiac catheterization (Cath.) applying the Gorlin formula were performed in 100 patients over a wide range of AVAs. The severity of the aortic stenosis (AS) was defined by consensus of at least two methods and systematic over-or underestimation of AVA associated with ejection fraction (EF), AR or severity of the AS for each method in relation to the other two methods were assessed in a repeated measure ANOVA model.

AVA (cm^2) by	Ejection fraction (%)			Aortic regurgitation		
	≤ 40 n = 26	≥ 40 ≤ 55 n = 34	> 55 n = 40	No n = 33	Mild n = 45	Mod/Sev n = 22
TEE	1.76 ± 0.89	1.27 ± 0.76	1.29 ± 0.68	1.73 ± 0.84	1.18 ± 0.70	1.38 ± 0.74
TTE	1.70 ± 0.82	1.34 ± 0.77	1.34 ± 0.70	1.79 ± 0.79	1.21 ± 0.71	1.34 ± 0.65
Cath.	1.78 ± 0.91	1.36 ± 0.81	1.37 ± 0.74	1.85 ± 0.84	1.26 ± 0.74	1.35 ± 0.79

AVA (cm^2) by	Degree of Aortic Stenosis			
	Minimal n = 26	Mild n = 28	Moderate n = 18	Severe n = 28
TEE	2.43 ± 0.45	1.64 ± 0.22	0.90 ± 0.23	0.55 ± 0.09
TTE	2.46 ± 0.26	1.62 ± 0.32	0.93 ± 0.18	0.61 ± 0.18
Cath.	2.58 ± 0.36†	1.69 ± 0.26	0.94 ± 0.20	0.58 ± 0.16

†Cath. significantly higher than both TTE&TEE

Conclusion: AVA determinations by TEE, TTE and Cath. in patients with AS are equally accurate and not influenced by EF or AR and can be used interchangeably in cases with impaired left ventricular function or significant aortic regurgitation.